OBITUARY NOTICES OF FELLOWS DECEASED.

RUDOLF JULIUS EMMANUEL CLAUSIUS was born on the 2nd January, 1822, in Cöslin, in Pomerania. He was the sixth son of the Rev. C. E. G. Clausius, D.D., Councillor of the Royal Government School Board, and later, Superintendent in Ueckermünde.

After the completion of his studies in the Gymnasium in Stettin, he attended the University of Berlin from 1840 to 1844. In the Easter of 1844 he passed his examination "pro facultate docendi," and then finished his year of probation at the Frederic-Werder Gymnasium. Here he taught the higher classes mathematics and physics. In the autumn of 1846 he entered Boeck's Royal Seminary for higher students. On the 15th July, 1848, he took his degree in Halle "eximia cum laude" (subject of dissertation—"De iis Atmosphæræ Particulis quibus Lumen reflectitur"). On the 25th September, 1850, he was invited to be Professor of Physics in the Royal Artillery and Engineering School at Berlin. On the 18th December he delivered his inaugural lecture as *docent* at the University of Berlin ("De Motu Corporum rotantium in Aëre resistente"). On the 29th August, 1855, he was called to be Ordinary Professor in the Polytechnicum in Zurich, and also at the same time in the University of Zurich. In 1867 he was appointed Professor in the University of Würzburg, and in 1869 he went to Bonn, where he fulfilled his duties till the day of his death, the 24th August, 1888.

While at Zurich he married, on the 13th November, 1859, Adelheid Rimpam, of Brunswick. They had six children, of whom two daughters and two sons are alive. His wife died in 1875, and he married again, in 1886, Sophie Sack, of Essen, by whom he had one son.

His brother, Herr Robert Clausius, thus writes of the character of this great man:—

"I had often the opportunity of admiring the rare energy and clearness with which, in a small study and with limited means, he untiringly pursued his great scientific aims. A chief characteristic was his sincerity and fidelity. Every kind of exaggeration was opposed to his nature. Even as a youth all intimate with him learnt to esteem his reliability and truthfulness. In the Gymnasium and in all circumstances of his later life the greatest confidence and trust

were placed in him. His judgment, which was guided by the strongest feeling of rectitude, was highly valued. Another important trait was his unbending and firm faithfulness to duty, to which he was true in all affairs of life up to his death. Even on his last bed of sickness he held an examination. He was the best and most affectionate of fathers, fully entering into the joys of his children. He himself supervised the schoolwork of his children. He was simple and natural in his intercourse and possessed of a rare modesty. He was never tired of sacrificing himself in cases of necessity, and though immersed in abstract studies he always kept a warm heart for everything human. He was a great, noble-minded, good man, whom all who knew more intimately have loved and esteemed, not only on account of his scientific celebrity but especially on account of his noble, manly qualities.

"His burning patriotism did not permit him to stay idly at home during the war 1870–1. He undertook the leadership of an ambulance corps, which he formed of Bonn students. At the great battles of Vionville and Gravelotte he helped to carry the wounded from the battle and to lessen their sufferings. For his services in this campaign he received the Iron Cross. A contusion in his leg which he received on the field of battle caused him great pain for many years and often necessitated his driving to his lectures. On the doctor's advice, at the age of 56 he learnt to ride, and became an excellent horseman. Riding proved very beneficial to his health."

One of his sons thus writes of him :—

"The principal trait in my father's character was, without doubt, the splendid truthfulness of his nature. In his deeds and words he never could tolerate anything ambiguous, and particularly as regards himself he cherished no self-deception. For that reason he never suffered from the discovery of the motives of his actions; from thence sprang his thoroughly noble nature as well as his great modesty and the delight which he always felt, and was never too proud to express, at the recognition of his work; from thence his dislike to all smattering and superficiality in which he suspected some untruthfulness. Another remarkable characteristic was the uncommon one of seeing only the best side of his neighbours. He hardly noticed their faults, and when he did he had not the least inclination to cheap mockery. The general impression which he received of people was formed from the more or less strong development of their good qualities and was little dimmed by the presence of this or that defect. His hearty, pleasant, always thoroughly genuine address towards everyone was the result of this trait. Only when he discovered untruthfulness did he take a deep aversion."

Clausius received the following offers of posts :—

In 1858 to the Polytechnicon of Carlsruhe; in 1862 to the

Polytechnicum of Brunswick; in 1866 to Vienna; in 1868 to Munich; in 1871 to Strasburg; in 1883 to Göttingen.

He received the following orders and titles:—

When Professor in Würzburg he was appointed Court Councillor; in 1868, as Professor in Bonn, he was appointed Privy Councillor; in 1870 he received the Huygens Medal; in 1871 the Iron Cross; in 1873 the Order of the Crown, 3rd Class; in 1879 the Order of the Red Eagle, 3rd Class, and the Copley Medal: in 1881 he was named Officer of the Legion of Honour; in 1882 he was appointed Doctor of Medicine *honoris causâ* in Würzburg; in 1883 he received the Poncelet prize; in 1884 the Order of the Prussian Crown, 2nd Class; in 1885 the Bavarian Maximilian Order. During 1884–5 he was Rector of the University of Bonn, and for six months was Curator of this University. He took part in the academic education of Prince William, afterwards Emperor of Germany. In 1887 he was invited to be one of the Curators of the New Imperial Physical and Technical Institution. In 1888, at the Investiture of the Order for Art and Science, he was appointed Hereditary Knight.

He received the following honours from Learned Societies:—

In 1857 Hon. Mem. Harlem; in 1859 Hon. Mem. of the Engineers of Scotland and Corresp. Mem. Erlangen; in 1865 Corresp. Mem. of the Institute of France; in 1866 Hon. Mem. Frankfurt-am-Main, and Hon. Mem. Dublin and Corresp. Mem. Göttingen; in 1868 Royal Soc. Lond.; in 1869 Hon. Mem. Nat. Hist. Soc. Zurich; in 1871 Elected Mem. Munich; in 1872 Elected Mem. Pest; in 1873 Corresp. Mem. Bologna and Elected Hon. Mem. Boston; in 1875 Hon. Mem. Civil Engin. Lond., Elected Corresp. Mem. Vienna, and Mem. Brussels; in 1876 Corresp. Mem. Berne, Society of Arts Geneva, and Hon. Mem. Nat. Hist. Soc. Basel; in 1877 Elected Mem. Göttingen; in 1878 Elected Mem. Stockholm, Elected Mem. Naples and St. Petersburg; in 1879 Mem. Halle Natural Hist. Soc. and Elected Mem. Ling.; in 1882 Corresp. Mem. Milan, Corresp. Mem. Turin, and Hon. Mem. Mech. Eng. New York; in 1883 Elected Mem. Washington, Hon. Mem. Erlangen, and Foundation Mem. Internat. Soc. of Electricians; in 1884 Corresp. Mem. Cherbourg and Corresp. Mem. Lucca; Hon. Mem. Manchester, Mem. Amsterdam; in 1887 Hon. Mem. Brunswick, Hon. Mem. Hamburg, Ordinary Mem. Upsala; in 1888 Mem. Edin.

In his scientific work Clausius investigated the general mechanism of Nature rather than particular applications of the principles he discovered; he was constructively synthetical rather than analytical. It is remarkable how he was led by dim previsions, as when his theory of gases influenced his views on heat when his gas theory was yet quite imperfect; his greatest work is grouped round his insight into molecular structure. The other great branch of his work is connected with electromagnetic theory. As in the theory of heat, he

worked from the theory of matter to the theory of the steam engine, so in electromagnetism, he worked from the theory of electromagnetic actions to the theory of its industrial application to dynamos.

Clausius' first publications were concerned with the action of atmospheric dust on sunlight. This seems to have directed his thoughts to molecular physics, which was indirectly the foundation of his greatest work. Thermodynamics was the region he explored, and his exploration was guided by his insight into molecular physics. When Clausius was beginning his independent activity the investigations of Rumford, Davy, Mayer, Joule, and Helmholtz had conclusively shown that heat could be produced from work, while the thermodynamic speculations of Carnot, founded upon the assumed indestructibility of caloric, were receiving every day additional confirmation. There was an obvious difficulty here of which Carnot himself was doubtless aware. Of this difficulty, in 1849, Sir William Thomson writes, that if we abandon Carnot's fundamental axiom "we meet with innumerable other difficulties insuperable without further investigation and an entire reconstruction of the theory of heat from its foundations. It is, in reality, to experiment that we must look, either for a verification of Carnot's axiom and an explanation of the difficulty we have been considering, or for an entirely new basis of the theory of heat."

It was at this juncture that Clausius, without waiting for additional experiments, read, in the Berlin Academy on the 18th February, 1850, his paper, "Ueber die bewegende Kraft der Wärme, und die Gesetze, welche sich daraus für die Wärmelehre selbst ableiten lassen."

Carnot had assumed that a heat engine gave out the same heat at the lower temperature as it took in at the higher, and founded his theory on this assumption and upon the impossibility of perpetual motion. Clausius, in the first place, emphasised that the heat given out must be less than the heat taken in by an amount equivalent to the work done, that this was required by the First Law of Thermodynamics, the equivalence of Heat and Work. Thus modified, Carnot's theorems could no longer rely for their proof on the impossibility of perpetual motion, and it was Clausius' great discovery to found Thermodynamics upon the New Second Law of Thermodynamics, "That heat tends to flow of itself from hot to cold bodies." On these foundations Clausius raised again the Theory of Thermodynamics, and thenceforward there was no serious doubt as to its security. Several different ways of stating the Second Law of Thermodynamics have been advocated, and objections have been raised to each of them. Of these things Clerk Maxwell writes that Clausius "first stated the principle of Carnot in a manner consistent with the true theory of heat." Of the varieties of statement he writes: "By comparing together these statements the student will be able to

make himself master of the facts which they embody, an acquisition which will be of much greater importance to him than any form of words on which a demonstration may be more or less compactly constructed."

There can be no doubt that Clausius was the first to throw a clear light upon the then dark and doubtful foundations of Carnot's theorem. Sir William Thomson writes of this in 1851, "the merit of first establishing the proposition upon correct principles is entirely due to Clausius."

As Professor Willard Gibbs says, "Rankin was attacking the problem in his own way with one of those marvellous creations of the imagination of which it is so difficult to estimate the precise value." The question of the amount of mechanical effect to be derived from heat, he further says, "was completely answered, on its theoretic side, in the memoir of Clausius, and the science of thermodynamics came into existence." "It might be said, at any time, since the publication of that memoir, that the foundations of the science were secure, its definitions clear, and its boundaries distinct." To Clausius then be the honour of making a science of Thermodynamics.

Clausius' subsequent work in this line consists essentially in working out the results of the law he discovered, and in investigating its foundations on general dynamical principles applied to molecular physics. In working out the results of his law he explored in two directions. He applied his discovery to work out the theory of the steam engine, and of many known phenomena, and also to discover properties of matter revealed by his analysis. This latter line is contiguous with his exploration of the dynamical foundations of the theory of heat. His analysis revealed the existence of eutropy as a property of matter, a property for which mankind has no sense, such as exists for feeling temperature, and which consequently escapes attention, and is most difficult of apprehension; so difficult, indeed, that although fundamentally as important as temperature in the theory of steam engines, its existence is ignored by all except the very foremost amongst those who study the working of steam engines. Clausius has left little to be done in the theory of heat engines except to work out, in the lines he has laid down, the details that experiments may prove to be most important. Clausius applied his theory to investigate the laws of specific and latent heat, of saturated steam, of the relations of heat and electricity in conductors, in thermopiles, and in electrolytes, and to the laws of radiant heat. He showed that radiant heat was no exception to the law that heat flows of itself from hot to cold bodies, and so proved the futility of the ingenious suggestion that the death of the universe by the degradation of energy might be avoided by the reconcentration of heat radiations by reflection from the confines of the ether. He showed

that the radiating power of black bodies in various media was proportional to the square of the refractive index of the medium, which involves a corresponding law of radiation of electromagnetic energy.

In all these applications his attention was constantly directed to the underlying molecular motions which explained the phenomena on dynamical principles. It was in this connexion that he investigated the dynamical foundations of the Second Law of Thermodynamics and the molecular theory of gases and of electrolysis.

In quite an early investigation he had been dominated by the conception that heat in a body can be considered as separated into two parts, one the kinetic energy of atoms, and the other the potential energy of forces between atoms. His later investigations were elaborations of these conceptions by the application of statistical methods, and by mathematical analysis of the highest order. He showed that the heat in a body could be expressed as the product of two factors, one proportional to the mean kinetic energy of the atoms, and the other depending on the mass, velocity, and period of their motions. These factors may be identified with temperature and entropy, and so furnish a dynamical basis for the theory of heat. Involved in these investigations was the Theorem of the Virial, which is so important in the dynamics of stationary motion. His theory is in accordance with much that we know, though it neglects radiation, and forces between molecules depending on their motions and positions, which may be systematically different before and after collision. With the ether among the molecules it is almost impossible but that some such forces exist, while the success of dynamical theories that neglect them seems to show that their effect cannot be very great.

While Clausius was elaborating these general results, he attacked the simpler case of the molecular theory of gases. That the properties of gases were in some way due to the motions of their molecules was a hypothesis as old at least as Bernoulli, but it was Clausius who raised it to the rank of a theory, and he has been described by Clerk Maxwell as the principal founder of the science. He showed how Boyle's and Dalton's laws followed from the theory, and how they were approximate; he proved the existence of intramolecular energy, and the necessity for Avogadro's law, and for the equality of mean energy of translation; and, insisting on the necessity for two atoms in a molecule, hastened the advent of the change in atomic weights which chemists were adopting; he investigated the length of the mean free path of a molecule, and the rates of diffusion and conductivity of heat in gases.

In connexion with the molecular theory of matter, Clausius had as early as 1851 investigated some of the laws of evaporation, and

had shown that the law of corresponding temperatures that Groshans modified from Dalton involved the law that at any given pressure the latent heat of vaporisation per unit volume of many substances was the same. After Van der Waals' memorable paper on the continuity of the liquid and gaseous states, Clausius published an elaborate investigation of this subject, in which he developed the application of a rather complicated formula, and showed that it represented the experiments throughout an enormous range with wonderful accuracy. There is a measurable departure from the law in calculating the compressibility of the liquids. To facilitate the application of this formula, Clausius invented and calculated the values of a special transcendental.

Electricity and magnetism attracted Clausius' attention from time to time, at first in connexion with heat and molecular physics, and afterwards with reference to the theory of electrokinetic actions. In 1858 he developed the theory that the molecules in electrolytes are continually interchanging atoms, and that the effect of electric force is to direct the interchange and not to cause it. It seems, however, possible that as synchronous systems near the solar system might break it up, while asynchronous ones might not, so a polarisation of the atomic motions in a liquid might result in a proportionate breaking up of the molecules which before this introduced regularity were stable. In reply to Hittorff's objection that gases should obey Ohm's law, Clausius answered that there were too few molecules. This can hardly be considered conclusive in presence of electrolytic conduction in very dilute aqueous solutions. His theory, however, explains almost all the known facts of electrolysis, and has been extended by others to explain many other phenomena with most remarkable success. He investigated electric osmosis, and hints that it is produced by electric forces due to charges over the surfaces of the pores in the diaphragm. He remarked that the resistance of pure metals is proportional to their absolute temperature.

His electrokinetic theory, founded on a theory of action at a distance between electrical elements moving in conductors, led to the conclusion that the action between the elements must depend on their absolute velocity and not on their relative velocity. This practically postulates a medium with reference to which the elements move, and by which the actions are propagated.

With the great development of electrodynamics as a machine for applying energy to do man's work, Clausius repeated his exploration of the theory of the steam engine, that great machine for applying heat energy to do work, and investigated on broad principles the theory of dynamos. Some of his work in this direction is superseded by the rapid development of the science and its applications, but his insight into the problem is evidenced by his having been one

of the first to notice hysteresis, which he describes as the forces resisting magnetisation being like friction.

It is to be regretted that in his electromagnetic theory Clausius was led by the algebraic methods of Weber rather than by the geometrical insight of Faraday, or by some mechanical theory, such as directed his steps in thermodynamics. If his constructive genius had been here well directed, there might now exist a satisfactory theory of electromagnetic action; he might have founded the theory of ether as well as of gas; he had genius enough to do it.

Though not himself an experimentalist, he valued and was eminently able to criticise and use the results of experiment. He had that clear grasp of natural phenomena which leads to a right interpretation of them, and that concrete practical conception of them that leads to a continual reference back of the interpretation to experimental numerical verification. He was a noble example of the spirit that devotes itself to directly benefiting mankind, and that does not waste time on petty elaborations of pretty problems. He was in the highest sense practical, his work is eternal, and his memory will live as long as mankind reveres its benefactors.

G. F. F. G.

Sir William Gull died on the 28th day of January, 1890, at his house in Brook Street, in his 74th year. His was one of the many distinguished names which refute the imputation of dulness upon the Eastern counties. He was born in the north-east corner of Essex, at one of the many villages which retain the old English name of Thorpe. While he was still a child his father died, and he was dependent for his education upon his mother's character and his own exertions. While teaching in the village school, he attracted the attention of the late Mr. Benjamin Harrison, for many years the Treasurer of Guy's Hospital, and the wise ruler of its Medical School. Thorpe-le-Soken lay in the midst of the Essex estates of the Hospital, and the Treasurer performed all the duties of a good landlord. Telling the friendless youth, "If you will help yourself I will help you," he brought him up to London, and gave him employment in transcribing Museum catalogues, and other clerical work in the Hospital counting-house. While thus employed Gull matriculated at the University of London in 1838, and by the Treasurer's influence was admitted to attendance on the courses of lectures at Guy's. His industry and talents procured him an honourable degree in 1841. Dr. Quain, who graduated the year before, Sir Edmund Parkes, who passed in the same year, and Sir Alfred Garrod and Dr. George Johnson, who followed in 1842, all became like him Fellows of this Society, and all, with the exception of the lamented Parkes, survive him.

Before he proceeded to the M.D. degree, at which he obtained the Gold Medal, he had been appointed by the Treasurer as a Supernumerary Resident Medical Officer, with special charge of the lunatic patients, who at that time occupied a department of the Hospital. For about nine years he seems to have been employed every day, and almost all day long, in the medical wards, acquiring by constant and close observation that familiarity with every variety of disease which afterwards stood him in such good stead.

In 1843 he received his first appointment in the Medical School, that of Lecturer on Natural Philosophy, and three years later wa transferred to the Chair of Physiology.

For three years, from 1847 to 1849, he was also Professor of Physiology in the Royal Institution.

In 1848 he married, and in 1851 he was appointed Assistant Physician to Guy's Hospital. In 1858 he was promoted to be full Physician, and for several years lectured on medicine with the late Dr. Owen Rees, also a Fellow of this Society, who died only a few months before Sir William Gull, after an illness of almost exactly the same nature and the same duration.

Very early in his career Dr. Gull obtained a large practice. His natural sagacity, his unusually large experience, his knowledge of disease and his knowledge of mankind, all combined in his favour. His striking physiognomy, his gravity and self-possession, his power of sympathy, and the well-chosen words in which he delivered his opinions fitted him to gain the confidence of his patients. But, apart from his remarkable practical skill, he showed a true scientific spirit in dealing with disease. He was unwearied in patient investigation, sparing no time where it was needful, although he wisely would refuse to trouble himself or his patient with minute collateral enquiries when once the essential nature of the case was apparent. He was never satisfied with the commonplace explanations which too often do duty for science, or the commonplace prescriptions which too often do duty for treatment. He had so thorough a knowledge of medicine that he would have been successful in spite of every personal defect, and his skill in dealing with patients was so consummate that he would have been successful if he had been ignorant of his profession.

In 1871 a severe attack of enteric fever from which the Prince of Wales suffered brought Dr. Gull's name into public notice, and his services were acknowledged by a Baronetcy, with a grant of Arms.

After his retirement from hospital practice, Sir William Gull did not allow his enormous consulting practice to absorb his energies or his interest. Few men have practised a lucrative profession with less eagerness to grasp at its pecuniary rewards. He kept up the honourable standard of generosity to poor patients which has been handed

down from Mead and Heberden ; and, with a liberality which is less common, he showed no jealousy of younger men sharing in his good fortune. Not one, but five or six of those who were rising in the profession, owed much of their success to his help. His name was familiar to the public, and his practice increased beyond his power to overtake his engagements. It is supposed that for several years he made as large an income as that of Sir Astley Cooper in 1814. But the fortune which he left at his death was, it is well known, only in part the result of his professional earnings.

Sir William Gull was independent in his relations with his patients, and was always glad to devolve as much of his work as he could upon younger colleagues. He also found time for the punctual performance of the public duties which his position imposed upon him. On the Council of this Society, on the Senate of the University of London, on the General Medical Council, and on that of the Association for the Advancement of Medicine by Research, he was a constant and influential attendant. He went through the various offices of Lecturer, Councillor, Orator, and Censor in the College of Physicians, and was generally looked to as its next President at the time of his last illness.

This was in the long vacation of 1887—just before his return to Brook Street to resume his work. He was attacked with apoplexy while walking in his grounds in Perthshire ; and, though the attack soon passed off, its significance was apparent, and to none more so than to the patient. He gave up practice and spent the next two years partly at Eastbourne and partly near Reigate. Repeated returns of his disorder, with varying severity, were watched by him with intelligent interest and full appreciation of their meaning. His intellectual faculties were spared him to the last, and nothing became him better than the fortitude and clear-sightedness with which he watched the process of decay, the friendly relations which he kept up or renewed with old colleagues or pupils or rivals, and the resigned submission with which he awaited the end. This came in a sudden and painless attack on the morning of the 28th of January in the present year. A few days later he was buried in the churchyard of his native village, beside his father and mother's grave, attended by representatives of his University, of the Royal Colleges of Physicians and Surgeons, of Guy's Hospital, and by a crowd of colleagues, friends, and pupils.

His striking appearance, his slow movements and deep voice, with his grave, thoughtful, but kind and sympathising manner, admirably fitted Sir William Gull to be an adviser and a helper in time of need. Few physicians have so completely acquired and retained the confidence of their patients.

As a hospital teacher, his method was minute and elaborate in investigation, clear and comprehensive in diagnosis, sagacious in fore-

cast, cautious and modest in treatment. While not inferior in accurate physical diagnosis to those who made this the whole of their art, he would never follow the routine system of diagnosis by successive exclusions, which, however useful to a junior student, is of very limited application at the bedside. In really obscure cases, where definite physical signs failed to indicate the nature, or even the existence of the disease, few physicians have approached the almost intuitive sagacity of Sir William Gull.

He was often supposed to be entirely sceptical as to treatment; and this scandal, though unjust, was no doubt fostered by some too sweeping words of contempt for polypharmacy and unverified therapeutical dogmas. In reality, his treatment was extremely careful, scrupulous, and minute, judicious in its aim, ingenious in its devices, and occupied with those little matters of detail which make so much difference to the comfort of the patient, and the success of any plan of therapeutic. His use of drugs was scarcely more sparing than the practice of other scientific physicians. In suitable cases no one wielded such powerful weapons as opium, mercury, arsenic, and digitalis with more confidence and skill. He used iron and quinine and acids, and bitters and purgatives much as others use them, but with a full recognition of the limited power of drugs, the natural limitations of acute disease, and the inevitable progress of degeneration and decay.

His eminence as a clinical teacher, a lecturer, and a practitioner was so conspicuous, that his merits as a pathologist and observer have scarcely received the credit they deserve. It is not too much to say, that he takes rank among the five or six Englishmen of his generation who advanced medical knowledge at more than one important point. He never published a book, and his papers are scattered in the volumes of the 'Guy's Hospital Reports' and in the Transactions of Societies. In one of the earliest papers which he published (in conjunction with Dr. Addison) was given almost the first notice and the first complete description of the remarkable disease of the skin known as Xanthelasma. His papers on Intermittent Hæmaturia, on the Treatment of Rheumatic Fever, on the Treatment of Tænia, and on Fictitious Urticaria were all accurate and original contributions to clinical knowledge. But his articles on Paraplegia in the 'Guy's Reports,' and on Abscess of the Brain in 'Reynolds' System of Medicine,' established pathological facts of primary importance. The paper which he published, in conjunction with Dr. Sutton, upon "Arterio-capillary Fibrosis" deals with a subject of great difficulty which is still, and probably will long remain, under investigation. It undoubtedly gave a new point of view—and a most instructive one—to the student of chronic Bright's disease. His account of Anorexia Nervosa was also marked by keenness of discrimination and breadth

of view, and it anticipated much that has since been written. The last important paper he published was on a Cretinoid Condition in Adult Women. It announced in succinct and modest fashion the discovery of a remarkable form of disease, up to that time quite unrecognised, and the accuracy of its description as well as the justice of its pathological views have since been entirely confirmed.

Foremost among clinical physicians of his time, and eminent among the pathologists, remarkable for the breadth of his views, the liberality of his conduct, and the native force of his character, Sir William Gull occupied an eminent position during his life, and has left a record of work which worthily answers to his great reputation.

P. H. P. S.

Stephen Joseph Perry was born in London on August 26th, 1833. His early education was received at Gifford Hall School, from whence he went to the Benedictine College at Douay, and then to Rome to study for the priesthood. Resolving to join the Society of Jesus, he returned to England, and on November 14th, 1853, entered on his novitiate, and after two years went to France, where he stayed for a year, returning to Stonyhurst to enter upon a course of mental philosophy and physical science. His great ability in mathematical studies decided his superiors in the Order to allow him to devote himself specially to this branch of study, with the result that he stood sixth on the Mathematical Honours List of London University in 1858, during which year he attended lectures by De Morgan at London, and by M. Bertrand and others at Paris. On his return to Stonyhurst in 1860 he was appointed Professor of Mathematics and Director of the Observatory, which posts he filled for three years, when he went to St. Beuno's College, North Wales, to complete his theological studies previous to his ordination as priest, in 1866.

In 1868 he resumed his work at Stonyhurst as Professor and Director of the Observatory, and continued there until his death, only leaving the College to take part in scientific expeditions.

Previous to the appointment of Father Perry to the directorship, the work done at Stonyhurst Observatory had been chiefly meteorological and magnetic; it was selected as a first-class meteorological station in 1866.

In 1867 the astronomical department was much extended, more powerful instruments were acquired, and the work undertaken very much increased. Spectroscopy was commenced at Stonyhurst in 1870, and since then has formed a large portion of the astronomical work carried on there. In 1872 regular observations of the phenomena of Jupiter's satellites were begun with the 8-inch Troughton and Simms equatorial, and with one considerable break, 1875—77, have been continued up to the present time.

In 1875 Father Perry instituted a regular series of drawings of the markings on the Sun from a projected image of $10\frac{1}{2}$ inches diameter, formed on a drawing board attached to the telescope. This work was supplemented by spectroscopic examination and measurement of the chromosphere and prominences, and after 1882 by systematic spectroscopic observations of Sun spots. In addition to the researches in solar physics, in connection with which the name of Father Perry has become so well known, the ordinary work of an observatory has been most diligently carried on at Stonyhurst, the results of which for the most part have been recorded in the publications of the Royal Astronomical Society.

It was not, however, in his work in the Observatory and College that Father Perry found an outlet for his untiring energy. His services were always at the disposal of scientific societies, and he took part in nearly every astronomical expedition of his time, and although a martyr to sea sickness, he was always ready and willing to undertake any voyage and undergo any hardship in the cause of the science he loved.

His first important scientific work was done in 1868, when, in conjunction with Father Sidgreaves, S.J., he made a magnetic survey of the West of France. With the Stonyhurst instruments complete sets of observations were made at fifteen stations during that year, and the work being continued the year following observations were obtained at nineteen other positions in the East of France, and thus a valuable and reliable magnetic survey of that country was completed. In 1871, assisted by Mr. W. Carlisle, of Stonyhurst, Father Perry carried out a similar work in Belgium, where the disturbing effect of the coal measures was very clearly indicated in the results obtained, which, together with those of the survey of France, were published in the 'Philosophical Transactions of the Royal Society.'

In 1870 Father Perry was appointed chief of the Solar Eclipse Expedition to Cadiz, his work being principally spectroscopic; and in 1874 he was selected by the then Astronomer Royal, Sir G. B. Airy, to take command of the Transit of Venus Expedition to Kerguelen Island. On September 20th he and his party left the Cape of Good Hope for Kerguelen Island in H.M.S. "Volage," on a journey attended by great difficulties and dangers, owing to the fearful weather usually prevailing off Kerguelen Island. Intense as must have been the suffering of Father Perry during the voyage, and severe the hardships of a nineteen weeks' sojourn on the "Island of Desolation," as he called it, all were cheerfully borne, every personal consideration being sacrificed to the astronomical interests of the Expedition. The observations of this transit were imperfect on account of haze, and the necessity of determining the exact longitude of their station prolonged the visit of Father Perry and his companions until February

26th, 1875, when the supply of provisions ran short, and it was not deemed prudent to stay longer. The passage to Durban was very rough, the "Volage" being overtaken by a cyclone and sometimes rolling 45°. Besides the observations of the transit, magnetic observations were made at the Cape, Kerguelen, Bombay, Aden, Port Said, Malta, Palermo, Rome, Naples, Florence, and Moncalieri; and on his return to England Father Perry gave an account of his work in a lecture at the Royal Institution.

In 1882 he again took charge of a Transit of Venus Expedition, this time being stationed in Madagascar, and accompanied by Father Sidgreaves and Mr. Carlisle, his former assistant in Belgium. The party reached their destination on October 22nd, in H.M.S. "Fawn." Again the results obtained were incomplete, wind and sand-storms interfering with the work, but some very good observations were made notwithstanding these difficulties. At the eclipse of August 29th, 1886, Father Perry accompanied the expedition to the West Indies, and was stationed at Carriacou. His spectroscopic observations were communicated to the Royal Society, and published in the 'Philosophical Transactions.'

In 1887 he was one of the observers sent by the Royal Astronomical Society, at the request of Professor Bredichin, to Pogost, on the Volga; but the sky was cloudy and no results were obtained.

Father Perry was again, in 1889, placed in command of an expedition sent by the Royal Astronomical Society, to the Isles de Salut, off French Cayenne, to photograph the corona during the eclipse of December 22nd. He and his assistant, Mr. Rooney, reached Barbadoes on November 26th, and arrived at his station on December 7th, after a trying voyage from Barbadoes, in H.M.S. "Comus," during which Father Perry suffered severely. Every assistance was afforded by the French Commander, and by the officers and crews of H.M.SS. "Comus" and "Forward" during the preliminary arrangements, but the necessary adjustments required exposure to the unhealthy night air, and this so told upon Father Perry, in his already weakened state, that on the day before the eclipse he was very ill indeed from dysentery; so ill that it was feared that he would be unable to take part in the observations of the eclipse. However, by a tremendous effort he overcame his pain and weakness sufficiently to successfully carry out all the instructions he had received, but, exhausted by this great effort, he became dangerously ill after the excitement which had sustained him was over, and was taken on board the "Comus." On December 26th he was slightly better, but, a relapse occurred and Father Perry died at 4.30 P.M., on December 27th. His body was interred in the Catholic Cemetery at Demerara, on December 28th.

Father Perry was a very popular and able lecturer. On several occasions he has lectured at the Royal Institution, the last time, a

few months before his death, on the work at Stonyhurst in connexion with solar physics during the last ten years. He also frequently lectured on astronomical subjects in the large towns in the North of England.

At the time of his departure from England, on the expedition that resulted in his death, Father Perry was contemplating a full discussion of all the work carried on at Stonyhurst, a work which would undoubtedly have formed a most valuable contribution to our knowledge of solar physics.

Father Perry was elected a Fellow of this Society in 1874, and in November, 1889, was made a member of the Council for the ensuing year. He became a Fellow of the Royal Astronomical Society in 1869, and was also a member of the Council of that Society. He was a Fellow of the Royal Meteorological Society and the Physical Society of London, and was President of the Liverpool Astronomical Society at the time of his death.

Of foreign Societies, he was a Member of the Accademia dei Nuovi Lincei, of the Société Scientifique de Bruxelles, and of the Société Géographique d'Anvers. He has been for several years a member of the Committee on Solar Physics appointed by the Lords of the Committee of Council on Education, and of the British Association Committee for comparing and reducing Magnetic Observations. In 1887 and 1889 Father Perry assisted at the International Congresses on Astronomical Photography held at Paris. In 1886 he received the degree of D.Sc. from the Royal University of Ireland.

In the death of Father Perry science has sustained a loss universally felt and most deeply regretted by all labourers in that branch to which his heroic self-sacrifice and never-failing energy have contributed so much. A. A. C.

William Kitchen Parker, born at his father's farm at Dogsthorpe, near Peterborough, June 23, 1823, died suddenly, of syncope of the heart, whilst visiting his second son, Professor W. Newton Parker, at Cardiff, July 3, 1890. Whilst cheerfully talking of late discoveries and future work in his favourite biological pursuits, he ceased to breathe. Accustomed to outdoor life, he was a true lover of nature from the first; the forms, habits, and voices of birds, especially, he knew at an early age. Village schooling at Dogsthorpe and Werrington, and a short period at Peterborough Grammar School, prepared him for an apprenticeship, at fifteen years of age, to Mr. Woodroffe, chemist and druggist, at Stamford; and three years afterwards he was apprenticed to Mr. Costal, medical practitioner, at Market-Overton. At Stamford, studying botany earnestly, he collected and named more than 500 species of plants. The fauna also of the fen lands attracted his attention—in Borough Fen, Thorpe Fen, Whittlesea, Deeping,

and Crowland. Both when living under his father's roof, and in his holidays afterwards, he kept many pet animals, and dissected whatever he could get, including a donkey and many birds. Of the latter he prepared skeletons; and of these he made large drawings at Market-Overton, which of late years he had some thought of publishing as an atlas of the osteology of birds.

Without the advantages of a university education, and with none of those aids to learning afforded by the science schools of the present day, he owed all the knowledge which he acquired to an intense love of nature, prompting and developing a taste for original research; and this, in spite of many obstacles, he assiduously cultivated to the last.

In December, 1844, he came to London, and entered Charing-Cross Hospital as a medical student. Having had an introduction to Dr. Todd, he was cordially received by him and encouraged to work in his physiological laboratory at King's College; and for a time he was prosector at Dr. Todd's lectures. He qualified as Licentiate of the Society of Apothecaries in 1849, and commenced to practice at Tachbrook Street, Pimlico. Soon afterwards he married Miss Elizabeth Jeffery. His wife's patient calmness under all difficulties and trials was a true blessing to a man of Mr. Parker's excitable temperament and indifferent health; and her unselfish life and wide-spread influence for good are well known in and beyond the family circle. Unfortunately, he was left a widower about four months before his death. He left three daughters and four sons. Of the latter, one is a Fellow of the Royal Society, and Professor of Zoology and Comparative Anatomy in the University of Otago, New Zealand; the second is Professor of Biology in the University College at Cardiff, South Wales; the third is an able draughtsman and lithographer; and the fourth has taken his diplomas of L.R.C.P. and M.R.C.S.

Mr. Parker had a good father, courteous and gentle by nature, conscientious, and earnest in business, who had worked hard to be able to give even his youngest son, Mr. W. K. Parker, "a start in life." From his placid and thoughtful mother he probably inherited much of his love of reading and readiness to learn.

Always energetic, in spite of ill-health, Mr. Parker enthusiastically carried on his medical work and his natural-history studies, especially in the microscopical structure of animal and vegetable tissues. Polyzoa and Foraminifera, collected on a visit to Bognor, and from among sponge-sands and Oriental sea-shells, especially engaged his attention. Having sorted, mounted, and drawn numbers of these Microzoa, he was induced, about 1856, by his friends W. Crawford Williamson and T. Rupert Jones to work at the Foraminifera systematically. His paper on the *Miliolitidæ* of the Indian Seas ('Transact. Microscopical Society,' 1858), and a joint paper (with T. R. Jones)

on the Foraminifera of the Norwegian Coast ('Annals and Mag. Nat. Hist.,' 1857) resulted; and the latter formed the basis of a memoir on the "Arctic and North-Atlantic Foraminifera" ('Phil. Trans.,' 1865). With T. Rupert Jones, and afterwards with W. B. Carpenter and H. B. Brady, Mr. Parker, down to 1873, described and illustrated many groups and species of Foraminifera, recent and fossil (see Sherborn's recent 'Bibliography of Foraminifera,' for these papers and memoirs), thereby establishing more accurately a natural classification of these Protozoa, determining their bathymetrical conditions, and therefore their value in geology. The important share which he took in the preparation of Dr. Carpenter's 'Introduction to the Study of the Foraminifera,' 4to, published by the Ray Society in 1862, is acknowledged in the preface of that handsome volume. That he did not neglect anatomical research is shown by memoirs in the Proceedings and Transactions of the Linnean, Zoological, and Microscopical Societies on the osteology (chiefly cranial) and systematic position of *Balæniceps* (1860), *Pterocles* (1862), *Palamedea* (1863), Gallinaceous Birds and Tinamous (1862 and 1866), Kagu (1864 and 1869), Parrot (1865), Ostriches (1866), *Microglossa* (1865), Common Fowl (1869), Eel ('Nature,' 1871), skull of Frog (1871), of Crow (1872), Salmon, Tit, Sparrow-hawk, Thrushes, Sturgeon, Pig, and Ægithognathous Birds (1873), Woodpecker and Passeres (1875). In the meantime the Ray Society had brought out his valuable 'Monograph on the Structure and Development of the Shoulder-girdle and Sternum in the Vertebrata' (1868); and his Presidential addresses to the Royal Microscopical Society (1872, 1873), and notes on the *Archæopteryx* (1864) and the fossil Bird bones from the Zebbug Cave, Malta (1865 and 1862), had been published. Subsequently the Royal Society's Transactions contained his abundantly illustrated memoirs on the skull of the Batrachia (1878 and 1880), of the Urodelous Amphibia (1877), the Common Snake (1878), Sturgeon (1882), *Lepidosteus* (1882), Edentata (1886), Insectivora (1886), and his elaborate memoir on the development of the wing of the Common Fowl (1888). In the 'Reports of the "Challenger"' is his memoir on the Green Turtle (1880). Those on the Cypselidæ ('Zoologist,' 1889), on *Tarsipes* (Dundee, 1889), the Duck and the Auk (Dublin, 1890), Gallinaceous Birds (for the Linnean Society), and the Hoatzin (*Opisthocomus cristatus*) for the Zoological Society, are his last works.

In former times a skull was regarded as little more than a dry, symmetrical, bony structure; or, if it were the cartilaginous brain-case of a shark, it was to most a mere dried museum specimen. When, however, the gradations of the elements of the skull, from embryonic beginnings, were traced until their mutual relations and their homologues in other Vertebrates were established, light was

thrown on the wonderful completeness of organic uniformity and singleness of design. How such studies can be carried on both by minute dissection and the modern art of parallel slicing, and not by one method alone, is to be gathered from his teaching.

As a draughtsman, Mr. Parker particularly excelled, and the value of his numerous memoirs was greatly enhanced by the excellence of the plates, the figures in which were drawn by himself. The article on the Anatomy of Birds in the 'Encyclopædia Britannica' also bears evidence to his industry and knowledge.

No man can have worked harder at science, in the intervals of professional duties, than he did, and it is scarcely surprising that the short intervals which he allowed himself for rest affected his health and compelled him to limit his practice. Like a true naturalist, however, he allowed his love of science to triumph over any desire for worldly gain, and it was well known to his friends that some of his best scientific work was accomplished during actual physical suffering, furnishing him, as he would say, with a pleasant distraction from his ailments.

In 1864 he was elected into the Zoological Society without the usual fees; and soon afterwards the Linnean Society paid him the same high compliment.

Mr. Parker was elected a Fellow of the Royal Society in 1865, and in the year following he received a Royal Medal for his comprehensive, exact, and useful researches in the developmental osteology, or embryonal morphology, of Vertebrates. Some few years afterwards the Royal Society made him an annual grant to aid in the prosecution of his studies; and, when that was discontinued, a pension from the Crown was graciously and appropriately awarded to him. A generous friend, belonging to a well-known Wesleyan family, more than once presented £100 towards the cost of some of the numerous plates illustrating his grand memoirs in the 'Philosophical Transactions.' He was elected Fellow of King's College, London, in 1875. In 1873 he had received the diploma as Member of the Royal College of Surgeons, and was appointed Hunterian Professor of Comparative Anatomy and Physiology, Professor Flower being invalided for a time; and aferwards both held the Professorship conjointly. His earnestness and wide views were well appreciated, opening up the modern aspect of comparative anatomy, and showing that both in Man and the Lower Vertebrates the wonderful structural development of their bony framework should be studied in a strictly morphological rather than a teleological method, and that its stages and resultant forms could be regarded only in the Darwinian aspect.

These lectures, given in abstract in the medical journals, became the basis of his 'Morphology of the Skull,' in editing which Mr. G. T. Bettany ably assisted him; and in a less scientific book, 'On

Mammalian Descent,' another friend (Miss Arabella Buckley, now Mrs. Fisher) similarly helped him. In the latter work, his own usual style frequently predominates, full of metaphor and quaint allusions, originating in his imaginative and indeed poetic mind, fully impregnated with ideas and expressions frequent in his favourite and much-read books—Shakespeare, Bacon, Milton, some of the old divines, and, above all, the old English Bible.

Separating himself from the trammels of foregone conclusions, and from the formulated, but imperfect, misleading conceptions of some of his predecessors in biology, whom he left for the teaching of Rathke, Gegenbaur, and Huxley, Professor W. K. Parker earnestly inculcated the necessity of single-sighted research, and the following up of any unbiassed elucidations, to whatever natural conclusion they may lead. Simple and firm in Christian faith, resolute in scientific research, he felt free from dread of any real collision between science and religion. He insisted that "our proper work is not that of straining our too feeble faculties at system-building, but humble and patient attention to what nature herself teaches, comparing actual things with actual" ('Proc. Zool. Soc.,' 1864); and in his "Shoulder-girdle, &c.," p. 2, he writes: "Then, in the times to come, when we have 'prepared our work without, and made it fit for ourselves in the field,' we shall be able to build a 'system of anatomy' which shall truly represent Nature, and not be a mere reflection of the mind of some one of her talented observers."

Again, at p. 225, in illustration of some results of his work, he says:—"The first instance I have given of the Shoulder-girdle (in the Skate) may be compared to a clay model in its first stage, or to the heavy oaken furniture of our forefathers, that 'stood pond'rous and fixed by its own massy weight.' As we ascend the Vertebrate scale, the mass becomes more elegant, more subdivided, and more metamorphosed, until, in the Bird class and among the Mammals, these parts form the framework of limbs than which nothing can be imagined more agile or more apt. So also, as it regards the sternum; at first a mere outcropping of the feebly developed costal arches in the Amphibia, it becomes the key-stone of perfect arches in the true Reptile; then the fulcrum of the exquisitely constructed organs of flight in the Bird; and, lastly, forms the mobile front-wall of the heaving chest of the highest Vertebrate."

Professor W. K. Parker was a Fellow of the Royal, Linnean, Zoological, and Royal Microscopical Societies; Fellow of King's College, London; Honorary Member of the Philosophical Society of Cambridge, and the Medical and Chirurgical Society. He was also a Member of the Imperial Society of Naturalists of Moscow, and Corresponding Member of the Imperial Geological Institute of Vienna, and the Academy of Natural Sciences of Philadelphia. In 1885 he

received from the Royal College of Physicians the Bayly Medal, "Ob physiologiam feliciter excultam."

In conversations shortly before his death, he often spoke of looking forward throughout his life-time (alas! how quickly shortened!) to continued application of all the energy he could devote to his useful work—at once a consolation to him and a duty.

He has well expressed his own view on biological pursuits, at p. 363 of the 'Morphology of the Skull':—"The study of animal morphology leads to continually grander and more reverent views of creation and of a Creator. Each fresh advance shows us further fields for conquest, and at the same time deepens the conviction that, while results and secondary operations may be discovered by human intelligence, 'no man can find out the work that God maketh from the beginning to the end.' We live as in a twilight of knowledge, charged with revelations of order and beauty; we steadfastly look for a perfect light, which shall reveal perfect order and beauty."

An unworldly seeker after truth, and loved by all who knew him for his uprightness, modesty, unselfishness, and generosity to fellow-workers, always helping young inquirers with specimens and information, he is lost to sight as a friend and father, but lives in the minds of his fellow-workers, of those whom he so freely taught, and of his bereaved relatives, as a great and good man, whose beneficent influence will ever be felt in a wide-spreading and advancing science by thoughtful and appreciative men.

T. R. J. and J. E. H.

Robert William Mylne, who died in July, 1890, aged 74, was for thirty years a Fellow of the Royal Society, to which also his father and his grandfather belonged. He was descended from a family eminent for several generations in architecture and engineering, his grandfather, Robert Mylne, F.R.S., and his father, William Chadwell Mylne, F.R.S., both having been engineers of eminence, and both attached to the New River Company.

Robert William Mylne was closely associated with his father in the active management of the New River Company. He was also for some years engineer to the Limerick Water Company, and was frequently consulted upon wells and water-supply both by the Government and private companies, and at one period of his life often gave scientific evidence on Water Bills before the House of Commons. He obtained a good water-supply for one of the sunk forts in the sea off Portsmouth, and was employed on the well at Tilbury and other fortifications.

In the department of geology he was, perhaps, best known, and his geological map of London and the neighbourhood, a work of immense labour and expense, was long a standard authority amongst

scientific men. He also prepared many other maps, which are less widely known.

He always devoted much time to the study of archæology and antiquarian matters, and was preparing an elaborate work on the architectural antiquities of Eastern Scotland at the time of his death. He was thirty years a Governor of Bridewell and Bethlehem Hospitals. He was also a Fellow of the Society of Antiquaries of London, and of Scotland, a Fellow of the Geological Society of England, and also of France, and a Member of the Smeatonian Society of Civil Engineers. He was also indirectly connected with the water works at Frankfort and Buda Pesth, and the Canal du Midi, in Southern France.

W. B. D.